

CLAIMS

WHAT IS CLAIMED IS:

1 1. A method of determining the position of a wireless device using
2 a wireless network having a plurality of receiver/correlators, each
3 receiver/correlator being positioned at a fixed location in the network, the
4 method comprising:

5 receiving a position request from the wireless device at a first
6 receiver/correlator and recording the receive time;

7 receiving the same position request from the wireless device at
8 a second receiver/correlator and recording the receive time;

9 receiving the same position request from the wireless device at
10 a third receiver/correlator and recording a receive time;

11 using the receive time recorded at the first receiver/correlator,
12 the receive time recorded at the second receiver/correlator, and the fixed
13 locations of each receiver/correlator to determine the position of the wireless
14 device; and

15 transmitting a position information packet back to the wireless
16 device indicating the global position of the wireless device.

1 2. The method of claim 1, further comprising the steps of:

2 receiving the same position request from the wireless device at
3 a third receiver/correlator and recording a receive time; and

4 using the receive time recorded at the first receiver/correlator,
5 the receive time recorded at the second receiver/correlator, the receive time
6 recorded at the third receiver correlator and the fixed locations of each
7 receiver/correlator to determine the position of the wireless device.

1 3. The method of claim 1, further comprising the step of:

2 synchronizing all the receiver/correlators in the plurality such
3 that an internal clock in each receiver/correlator is synchronized and
4 syntonized, thereby indicating the same time information.

1 4. The method of claim 3 wherein the step of synchronizing all of
2 the receiver/correlators is comprised of:

3 transmitting a first synchronization packet from the first
4 receiver/correlator to the second receiver/correlator, the first synchronization
5 packet having a first transmit time at which the packet was transmitted from
6 the first receiver/correlator;

7 receiving the first synchronization packet at the second
8 receiver/correlator and recording the receive time;

9 comparing the first transmit time of the first synchronization
10 packet with the receive time recorded at the second receiver/correlator;

11 synchronizing an internal clock in the second receiver/correlator
12 using a difference between the first transmit time and the receive time, the
13 known locations of the first and second receiver/correlators and a known
14 propagation delay between the first and second receiver/correlators.

1 5. The method of claim 1, wherein the step of receiving a position
2 request packet from the wireless cellular device at a first receiver/correlator
3 and recording the receive time is comprised of:

4 detecting the reception of each bit in a header of the position
5 request packet and using cross-correlation techniques to determine whether
6 the bits match a known bit pattern;

7 recording a time each bit is detected; and

8 averaging the recorded times for each bit thereby accurately
9 generating a general receive time which indicates the time at which the
10 position request packet is received.

1 6. The method of claim 5, wherein the step of detecting the
2 reception of each bit in a header of the position request packet is comprised
3 of:

4 sampling incoming packets at a rate equal to an inverse of a
5 rising or falling edge time and detecting any rising or falling edges;

6 determining whether the bit is high or low based upon the
7 detection of a rising or falling edge; and

8 comparing the bit detected to a bit in the same bit position in
9 the known bit pattern.

1 7. The method of claim 1, wherein the step of transmitting a
2 position information packet back to the wireless device indicating the global
3 position of the wireless device is comprised of:

4 a) creating a position information packet having:

5 a header portion which identifies the packet as a position
6 information packet;

7 a field for identifying the central server from which it is being
8 transmitted;

9 an information field identifying the wireless device for which
10 it is intended; and

11 a field identifying the position of the wireless device, as
12 determined by the central server; and

13 b) transmitting the position information packet to the wireless
14 device via the packet based network.

1 8. A system for identifying the position of a wireless device and
2 transmitting that position back to the wireless device, the system
3 comprising:

4 a plurality of receiver/correlators, each receiver/correlator being
5 positioned at a fixed location in the network for

6 receiving position request packets from the wireless
7 cellular device, thereby generating a trigger signal each time a

8 position request packet is received, the trigger signal used to
9 record a local time, as indicated by an internal clock, at which the
10 position request packet is received, and

11 generating timing packets which include information
12 about received position request packet, including time received;
13 and

14 a central server for receiving the timing packets from the
15 plurality of receiver/correlators and determining the position of the wireless
16 device using the information in various timing packets.

1 9. The system of claim 8, wherein the central server:

2 extracts timing information from a first timing packet received
3 from a first receiver/correlator and timing information from a second timing
4 packet received from a second receiver/correlator and determines a
5 difference between the two timing informations;

6 based upon this difference in time, the known locations of the
7 first and second receiver/correlators, and the known speed of the timing
8 packets, the central server uses known hyperbolic equations in order to
9 determine a first position curve along which the wireless device may be
10 located;

11 extracts timing information from the first timing packet received
12 from the first receiver/correlator and timing information from a third timing
13 packet received from a third receiver/correlator and once again determines a
14 difference between the two timing informations;

15 based upon this difference, the known locations of the first and
16 third receiver/correlators, and the known speed of the packets, the central
17 server uses known hyperbolic equations to determine a second position
18 curve along which the wireless device may be located, wherein this second
19 position curve will intercept the first position curve at two locations, either
20 of which may be the location of the wireless device;

21 extracts timing information from the second timing packet
22 received from the second receiver/correlator and timing information from the
23 third timing packet received from the third receiver/correlator and once again
24 determines a difference between the two timing informations; and,

25 based upon this difference, the known locations of the first and
26 third receiver/correlators, and the known speed of the packets, the central
27 server uses known hyperbolic equations to determine a third position curve
28 along which the wireless device may be located, wherein the third position
29 curve will intercept the first and second position curves at one location,
30 which will determine the location of the wireless device.

10. A plurality of receiver/correlators coupled in a wireless packet based network and each having a fixed location, the receiver/correlators being used for determining the geographic position of a wireless cellular device, each receiver/correlator comprising:

an internal clock; and

a synchronization packet detector for:

detecting synchronization packets which are used to synchronizing and syntonizing the internal clock; and

detecting position request packets from the wireless cellular device and generating a trigger signal each time a position request packet is received, the trigger signal used to record a local time on the internal clock at which the position request packet is received.

11. The receiver/correlators of claim 10, wherein each receiver/correlator further includes

a timing packet generator for generating a timing packet which identifies a particular position request packet and the time it was received at the receiver/correlator, the timing packet being transmitted to a central server for processing.

12. A packet based communications protocol for receiving a position request from a wireless device and transmitting position information

back to the wireless device, the packet based communications protocol comprising:

a position request packet which is transmitted from the wireless device to a receiver/correlator which includes a header having a known bit pattern which identifies the packet as a position request packet, and a field for identifying the wireless device from which it was transmitted; and

a position information packet which is transmitted from a central server to the wireless device which includes a header which identifies the packet as a position information packet, a field for identifying the central server from which it was transmitted, an information field identifying the wireless device for which it is intended, and a field identifying the position of the wireless device, as determined by the central server.

13. The packet based communications protocol of claim 0, further comprising:

a timing packet which is transmitted from the receiver/correlator to the central server, having a header which identifies the packet as a timing packet, a field for identifying the receiver/correlator from which it was transmitted, a field identifying timing information which includes a Δt time at which the position request packet was received at the receiver/correlator, and a field identifying the corresponding position request packet.